

**REMARKS**

The Office Action mailed December 4, 2008, has been received and carefully considered. The Title has been amended to correspond to the preamble of Claim 1. To the best of the undersigned attorney's information and belief, these changes contain no new matter.

**Claims 1-19 are pending in the Application and are submitted to be in allowable condition.** Claim 1 is independent.

**I. The rejection of claims 1 and 5 under 35 U.S.C. §103(a) as unpatentably obvious over Hickel et al. (US 5,580,612, hereinafter "Hickel") in view of Dai et al. (US 6,808,746, hereinafter "Dai") is respectfully traversed.**

1. The Examiner relies on the disclosure of Hickel for a method of arranging fullerenes on a substrate. The Examiner acknowledges that Hickel does not teach (1) that pressure is applied by controlling the surface pressure-area isotherm or (2) the fullerene species cylindrical fullerene, i.e., carbon nanotubes. The Examiner considers (1) to be inherent and points to Fig. 1. The Examiner relies on the disclosure of Dai for (2) wherein the Langmuir-Blodgett technique is used to deposit carbon nanotubes onto a substrate (see Cl. 1, line 62, through Col. 2, line 5).

2. Independent claim 1 is directed to a method of arranging carbon nanotubes at selective orientations on the surface of a substrate. The method includes the steps of chemically modifying purified carbon nanotubes by attaching organic macromolecules with hydrophilic and hydrophobic ends to the surface of the carbon nanotubes, and dissolving the chemically modified carbon nanotubes in water or a organic solvent to form a solution. The solution is then spread on a body of water to form a carbon nanotubes thin film. The thin film is then compressed and transferred to a treated solid substrate to form a layer of selectively oriented carbon nanotubes.

3. Hickel is directed to a method of producing of a layer element containing at least a layer of an amphiphilic molecule and one fullerene. This method includes dissolving a mixture of the amphiphilic molecule and the fullerene in a volatile organic solvent to form a solution (see column 3, lines 39 – 41). The solution is then spread on a water surface to form a film, and the film is compressed and transferred to a solid base (see Col. 3, lines 41-46).

4. Hickel does not disclose or suggest the following steps that are recited in claim 1: (1) *chemically modifying carbon nanotubes by attaching organic molecules with hydrophilic and hydrophobic ends to the surface of the carbon nanotubes*; and (2) *dissolving the chemically modified carbon nanotubes in water or an organic solvent*.

5. Hickel teaches making a mixture of amphiphilic molecules and a fullerene, but a mixture is submitted to be essentially different from a chemical modification because a chemical mixture is a simple combination two or more different materials without a chemical reaction occurring so that there is no chemical modification unlike step (2) of Applicant's independent claim 1.

6. Hickel teaches dissolving the mixture in a **volatile organic solvent** to form a solution. In contrast, Applicant's independent claim 1 specifies dissolving the chemically modified carbon nanotubes in **water or organic solvent** to form a solution. Because fullerenes are formed entirely of carbon, they are not water-soluble unless chemically modified to have hydrophilic surfaces. Thus, Hickel's teaching of using only volatile organic solvent for a solution is consistent with its teaching to form a mixture of fullerenes and amphiphilic molecules, in which the fullerenes remain water-insoluble due to a lack of chemically attached hydrophilic surface molecules. On the other hand, although carbon nanotubes, like fullerenes, are made entirely of carbon, they are chemically modified according to the claimed invention to provide organic molecules with **hydrophilic and hydrophobic** ends attached to their surfaces, and therefore they can be dissolved in water or organic solvent.

7. Indeed, Hickel teaches away from adopting a chemical modification step for the purpose of making a fullerene molecule water-soluble because it explains that "a characteristic feature of the Langmuir-Blodgett method [as used in Hickel] is that **water-insoluble** molecules . . . are spread from a solution . . . on the water surface" (emphasis added, Col. 3, lines 30 – 33)

and “[therefore in] particular, a mixture of the fullerene and amphiphilic compound is dissolved in a volatile organic solvent” (column 3, lines 39 – 41). In contrast, Applicant’s Specification at page 1, lines 14-17, and page 2, lines 7-10, teaches that the insolubility of carbon nanotubes in an aqueous solution is one of the major limitations for carbon nanotube application breakthroughs, and that one of the purposes of the present invention is to overcome this disadvantage. Therefore, not only does Hickel not disclose or suggest the features recited in claim 1, the step of chemical modification and the step of dissolving of the chemically modified carbon nanotubes in water, but Applicant believes that the language of Hickel also discourages any efforts to develop them.

8. Recognizing the shortcomings of Hickel, the Examiner proposes to modify the method of Hickel with the disclosure of Dai. The Examiner therefore relies on the disclosure of Dai for a method wherein the Langmuir-Blodgett technique is used to deposit carbon nanotubes onto a substrate (see Cl. 1, line 62, through Col. 2, line 5).

9. Dai discloses a process to prepare a substrate-free aligned nanotube film comprising: (a) synthesizing a layer of aligned carbon nanotubes on a quartz glass substrate by pyrolysis of a carbon-containing material in the presence of a suitable catalyst; and (b) etching the quartz glass substrate at the nanotube/substrate interface to release said layer of aligned nanotubes from the substrate.

10. While the Examiner considers that it would have been obvious to one of ordinary skill in the art to practice the method of Hickel using carbon nanotubes as a fullerene material in view of Dai, Applicant respectfully disagrees that this modification would meet Applicant’s independent claim 1.

11. **Applicant respectfully submits that the method obtained by modifying the disclosure of Hickel with the disclosure of Dai does not meet the method of Applicant’s independent claim 1.**

12. Dai pyrolyzes a carbon-containing material to form a layer of carbon nanotubes on the substrate, so that the method of Hickel modified by Dai would include such a step of pyrolyzing a carbon-containing material to form a layer of carbon nanotubes on the substrate. Applicant’s method is **essentially different** in that Applicant’s method chemically modifies

carbon nanotubes by surface attachment of organic macromolecules with hydrophilic and a hydrophobic ends to the carbon nanotubes, followed by the steps of dissolving, spreading, vaporizing, compressing, and transferring.

13. Since neither Hickel nor Dai teach Applicant's step of "***chemically modifying carbon nanotubes by attaching organic molecules with hydrophilic and hydrophobic ends to the surface of the carbon nanotubes***", the combination of Hickel and Dai does not teach this step so that **the combined disclosures of Hickel and Dai do not meet Applicant's independent claim 1**, and the claims depending there from, claims 2-19 for analogous reasons. In view of this, Applicant respectfully submits that no *prima facie* case of obviousness has been made out and this ground of rejection should be withdrawn.

Regarding rejections (II) – (VII) below, because claims 2-19 depend from claim 1, Applicant respectfully submits that dependent claims 2-19 are patentable for the same reasons given regarding claim 1. It is Applicant's belief that the tertiary references combined with Hickel in view of Dai do not disclose or suggest the features missing from the combination of Hickel and Dai needed to meet Applicant's independent claim 1. As such, Applicant respectfully submits that no *prima facie* case of obviousness has been made out by rejections (II) – (VII) below so that these grounds of rejection should be withdrawn.

II. The rejection of claims 2, 3, 16, and 17 under 35 U.S.C. §103(a) as unpatentably obvious over Hickel et al. (US 5,580,612) in view of Dai et al. (US 6,808,746), and further in view of Ligenza (US 2,930,722) is respectfully traversed.

III. The rejection of claim 10 under 35 U.S.C. §103(a) as unpatentably obvious over Hickel et al. (US 5,580,612) in view of Dai et al. (US 6,808,746), and further in view of Fujimaki et al. (US 4,009,305) is respectfully traversed.

IV. The rejection of claims 4 and 19 under 35 U.S.C. §103(a) as unpatentably obvious over Hickel et al. (US 5,580,612) in view of Dai et al. (US 6,808,746), and further in view of Bening et al. (WO/90/14221) is respectfully traversed.

V. The rejection of claims 6, 7, 11, and 15 under 35 U.S.C. §103(a) as unpatentably

obvious over Hickel et al. (US 5,580,612) in view of Dai et al. (US 6,808,746), and further in view of Uekita et al. (US 5,043,248) is respectfully traversed.

VI. The rejection of claims 8, 9, 12, and 13 under 35 U.S.C. §103(a) as unpatentably obvious over Hickel et al. (US 5,580,612) and Dai et al. (US 6,808,746), in view of Ligenza (US 2,930,722), and further in view of Uekita et al. (US 5,043,248) is respectfully traversed.

VII. The rejection of claims 2, 3, 16, and 17 under 35 U.S.C. §103(a) as unpatentably obvious over Hickel et al. (US 5,580,612) and Dai et al. (US 6,808,746), in view of Fujimaki yet al. (US 4,009,305) and Bening et al. (WO/9-/14221), and further in view of Uekita et al. (US 5,043,248) is respectfully traversed.

#### **CONCLUSION**

In view of the foregoing remarks, Applicants submit that claims 1-19 and the Application are in condition for allowance. Reconsideration and passage of this case to issue are therefore requested.

Should the Examiner consider that a conference would help to expedite the prosecution of this Application, the Examiner is invited to contact the undersigned to arrange for such an interview.

No fee is believed due. If any fee is deemed due, the Commissioner is hereby authorized to charge the same to our Deposit Account No, 18-0002 and is requested to advise us accordingly.

Respectfully submitted,



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Date

for Steven M. Rabin (Reg. No. 29,102)  
Rabin and Berdo, PC  
CUSTOMER NO. 23995  
1101 14<sup>th</sup> Street, N.W., Suite 500  
Washington, D.C. 20005  
Tel.: (202) 371-8976  
Fax: (202) 408-0924

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Amendment

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